

Biomechanics of MTBI

Rotational Forces more significant than linear
demonstrated using animal models

HIT (Head Impact Telemetry) in football

Ave. football impacts are 19 to 29g

Range producing concussion 60 to 120g

Usual threshold is 80g, rotation may lower this

For example: a head hitting a dashboard in a
25mph auto to brick wall crash is 100g

The Neurometabolic Cascade in Mild to Mod TBI & Severe TBI

Nonspecific depolarization and initiation of
action potentials

Release of excitatory neurotransmitters

glutamate and aspartate bind NMDA
receptor leading to further depolarization

Massive efflux of potassium

Increased activity of membrane ionic pumps
to restore homeostasis

Hyperglycolysis to generate more ATP

Lactate accumulation

Calcium influx and sequestration in mitochondria leading to impaired metabolism

Decreased ATP production

Calpain activation and initiation of apoptosis

Axolemmal disruption and calcium influx

Neurofilament compaction via phosphorylation or sidearm cleavage

Microtubule disassembly and accumulation of axonal transported organelles

Axonal swelling and eventual axotomy ³

MTBI Neuron Damage A Process NOT and Event

- MTBI rarely produces neuronal death as opposed to more severe TBI.
- MTBI recovery ranges from rapidly reversible cellular disruption to slow but complete recovery in moderate TBI.
- The process of MTBI is an energy crisis
- Disruption of cell membranes and ion fluxes create a need for more energy.
- Excitatory transmitters cause even more neuronal depolarization when less is needed.

- Edema and loss of cerebral blood flow regulation reduce delivery of substrate.
- Impaired metabolism disrupts the production of energy from within the cells.
- The mismatch of energy need to energy supply makes the brain less able to respond to a second injury potentially leading to longer lasting deficits.
- Long term memory deficits may result from dysfunctional glutamatergic (NMDA), adrenergic and cholinergic systems.
- Impaired cholinergic neurotransmission could lead to impaired new memory formation

Serum Biochemical Markers of MTBI

- S-100B is a calcium-binding protein found in astroglial and Schwann cells. It correlates with structural abnormalities on brain neuroimaging. Best results are when it is corrected against CK levels.
- Cleaved Tau Protein (CTP) not a good predictor of long term outcome.
- Further study is needed before serum markers are recommended for general use in diagnosis and prognosis of TBI & MTBI.